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HOW TO TIME DIMETHOATE SPRAYS AGAINST THE NANTUCKET PINE TIP MOTH

BY

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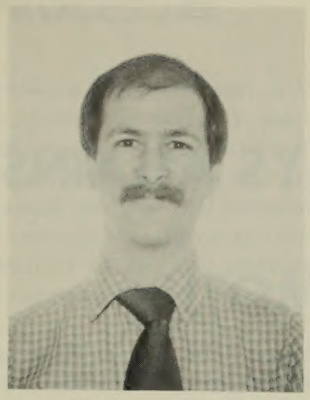

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Christopher G. Canalos owns and operates Georgia Christmas Trees, Inc. specializing in control of insect pests in Christmas tree plantations, and in tree brokerage. He holds a B.S. Degree in Biological Sciences from Ohio State University, an M.S. in Entomology and an M.S. in Forestry from the University of Georgia. He is interested in the use of pheromones in tip moth control, and in herbicide-insecticide interaction in pine plantings.

James A. Richmond is a Research Entomologist with the U.S. Forest Service at Research Triangle Park, N.C. He studied Biology and Chemistry at A & T State University, Greensboro, N.C., and received his Ph.D. Degree in Entomology from North Carolina State University. He served in the Air Force, and performed Biochemistry research at Duke Medical Center. His current research interests include control of regeneration insects in pine stands, colonization on natural and artificial insect diets, and the behavior and population dynamics of forest insects.

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INTRODUCTION

Larvae of the Nantucket pine tip moth feed inside of pine shoots and buds, especially within the upper one-third of the crown. After the destruction of this vigorously growing material, smaller shoots compete with each other for apical dominance, resulting in a bushy or deformed tree. There is also a decrease in tree height growth (Yates, 1960). This may be a problem in loblolly pine plantations managed for pulpwood or sawtimber, but is especially serious on Virginia pines grown for Christmas trees, where cosmetic appearance is important.

Christmas tree growers in the southern piedmont and coastal plain have attempted to control tip moths by spraying Cygon[R] (Dimethoate) or Orthene[R] (Acephate) every two weeks or every month throughout the growing season. Spraying on such a schedule often produces poor and inconsistent control. Good control can be obtained by using one spray, carefully timed to coincide with the most susceptible stage of each tip moth generation. This occurs during the first and second larval instars. We present here a simple technique by which a grower can predict the optimum spray date using only pheromone traps and daily maximum and minimum temperatures. Research leading to the development of this technique will be reported in Berisford, et al. (1983), and Gargiullo, et al. (unpublished). Cygon[R] was used in these studies because it is currently the most popular insecticide used to control tip moths.

PROCEDURE

This technique was developed in the Georgia piedmont, but probably applies to most of the southern piedmont as well, where the Nantucket pine tip moth has three generations per year. An extrapolation of the technique to the coastal plain will be presented below. The technique is performed in two steps.

Step 1: The beginning of each tip moth generation (i.e. adult emergence) must be determined by using pheromone traps (Fig. 1). Information on the availability of the pheromone traps and sex attractant lures can be obtained from the University of Georgia, Department of Entomology, Athens, Georgia[1/]. Eight to 10 traps should be placed at least fifteen feet apart throughout the plantation, on or before the following dates for each generation:

Generation 1	Generation 2	Generation 3
February 21	May 15	July 6

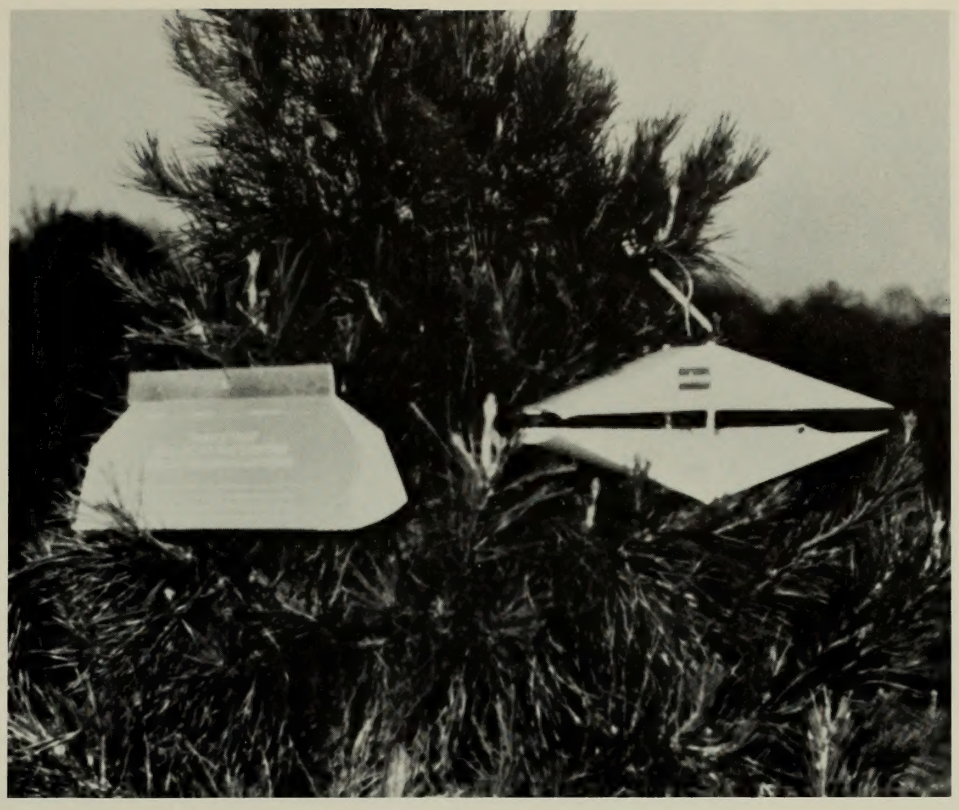

Fig. 1 - Two of the common types of insect traps which utilize pheromones or sex attractant lures.

Traps should be examined daily for moth catches (Figs. 2 and 3). When the first moth is found in any one of the traps, go to Step 2.

Step 2: Once the onset of a generation is determined, then degree-days (^{o}D, see Baskerville and Emin, 1969) must be accumulated daily, starting with the day on which the first moth was caught. Degree-days are accumulated day by day until the appropriate sum is reached. When this sum is reached, the following day is the optimum spray date. The required ^{o}D sums for each generation are:

Generation 1	Generation 2	Generation 3
439 ^{o}D	626 ^{o}D	480^{o}D; 840^{o}D

Note that although only one spray is needed for each of generations 1 and 2, two sprays are recommended for generation 3, because the period of activity is longer during that generation.

To find the daily ^{o}D contribution to the accumulating sum, the daily maximum and minimum temperatures are needed. A maximum-minimum thermometer may be obtained from a hardware store, nursery, or local weather reports may be used. Using the ^{o}D tables in the Appendix, find the maximum temperature along the top margin, and the minimum temperature along the left margin. The corresponding table entry is the number of ^{o}D for that day. Consult these tables each day as you accumulate ^{o}D toward the final sum.

Fig. 2 - Moths are caught on the sticky interior surfaces of the pheromone trap.

1/ Available information on products does not constitute an endorsement by the University of Georgia, The Georgia Forestry Commission nor the U. S. Forest Service.

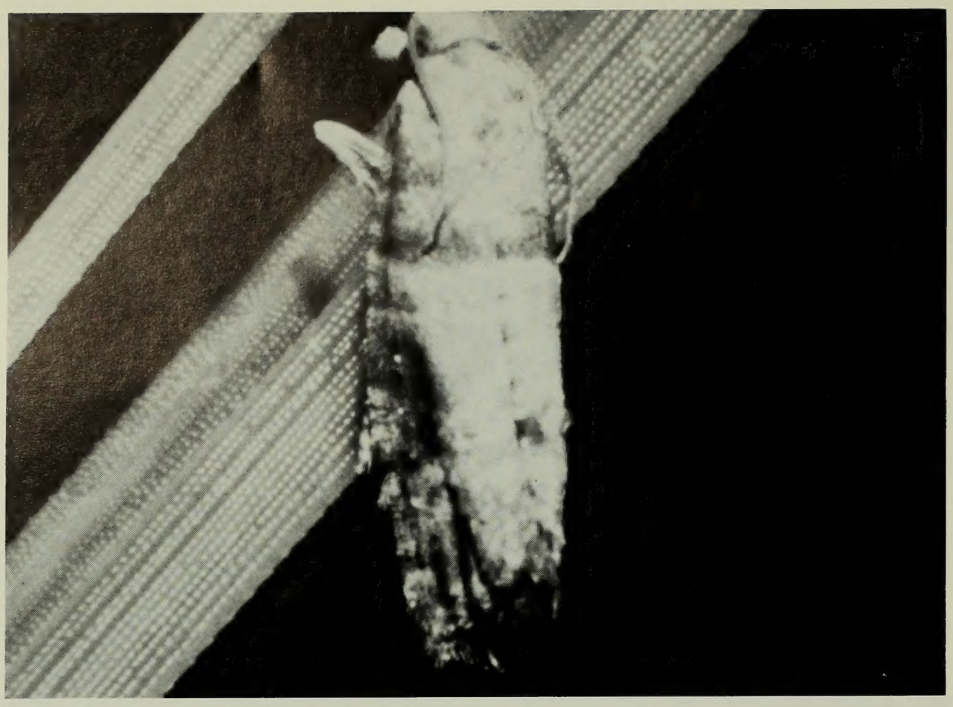

Fig. 3 - Adult Nantucket pine tip moth.

SPECIAL CONSIDERATIONS

1) During their first season in the field, very young pines should be sprayed twice per tip moth generation, according to the following ^{o}D sums:

Generation 1	Generation 2
375^{o}; $550^{o}D$	500^{o}; $800^{o}D$

Generation 3

$480^{o}D$; $840^{o}D$

Two applications are recommended because the phenology of seedlings is different, requiring different timing, and control on these young trees is critical if quality Christmas trees are to be produced. Tip moth attacks on these young trees can damage tree form considerably

2) The timing technique was developed for the Georgia piedmont areas. However, many Christmas tree plantations are in the coastal plain, where there are four tip moth generations per season. Some success might be obtained by using the following extrapolation of the technique, until more research can be performed specifically for the coastal plain.

Deploy pheromone traps on February 1, May 1, and June 20. Apply insecticide when the appropriate number of degree days are accumulated as for the three generations in the piedmont. After the last timed spray, apply insecticide on a schedule of once every two or three weeks through the middle of October.

DAILY DEGREE-DAYS FOR PREDICTION OF OPTIMUM SPRAY DATE FOR NANTUCKET PINE TIP MOTH

MAXIMUM TEMP *FAHRENHEIT*

MINIMUM TEMP *FAHRENHEIT*	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48
1-	6	5	5	5	5	4	4	4	3	3	3	3	2	2	2	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0
2-	6	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0
3-	6	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0
4-	6	6	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0
5-	6	6	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0
6-	6	6	5	5	5	5	4	4	4	3	3	3	3	2	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0
7-	6	6	5	5	5	5	4	4	4	3	3	3	3	2	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0
8-	6	6	5	5	5	5	4	4	4	4	3	3	3	2	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0
9-	6	6	6	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0
10-	6	6	6	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0
11-	6	6	6	5	5	5	5	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0
12-	6	6	6	6	5	5	5	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	1	1	0	0	0	0	0	0	0
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21-	7	7	6	6	6	5	5	5	5	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	0	0	0	0	0	0	0
22-	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	0	0	0	0	0	0	0
23-	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0
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25-	8	7	7	7	6	6	6	5	5	4	4	4	4	3	3	3	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0
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27-	8	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3	3	2	2	2	1	1	1	1	1	0	0	0	0	0	0
28-	8	8	7	7	6	6	6	5	5	5	4	4	4	4	3	3	3	2	2	2	2	1	1	1	1	0	0	0	0	0	0
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DAILY DEGREE-DAYS FOR PREDICTION OF OPTIMUM SPRAY DATE FOR NANTUCKET PINE TIP MOTH

MAXIMUM TEMP *FAHRENHEIT*

MINIMUM TEMP FAHRENHEIT	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79
1-	14	14	14	13	13	13	13	13	12	12	12	12	11	11	11	11	10	10	10	9	9	9	8	8	8	7	7	7	7	6	6
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33-	18	18	18	18	18	17	17	17	17	16	16	16	16	15	15	15	14	14	13	13	13	12	12	12	11	11	11	10	10	9	9
34-	19	18	18	18	18	18	17	17	17	17	16	16	16	16	15	15	14	14	14	13	13	13	12	12	11	11	11	10	10	9	9
35-	19	19	18	18	18	18	18	17	17	17	17	16	16	16	15	15	15	14	14	13	13	13	12	12	12	11	11	11	10	10	9
36-	19	19	19	18	18	18	18	18	17	17	17	17	16	16	16	15	15	15	14	14	14	13	13	13	12	12	11	11	11	10	9
37-	19	19	19	19	18	18	18	18	18	17	17	17	16	16	16	15	15	15	14	14	14	13	13	12	12	12	11	11	10	10	10
38-	20	19	19	19	19	18	18	18	18	18	17	17	17	16	16	16	15	15	15	14	14	13	13	13	12	12	11	11	11	10	10
39-	20	20	19	19	19	19	19	18	18	18	18	17	17	17	16	16	16	15	15	14	14	14	13	13	12	12	12	11	11	10	10
40-	20	20	20	19	19	19	19	19	18	18	18	17	17	17	17	16	16	15	15	15	14	14	13	13	13	12	12	11	11	11	10
41-	20	20	20	20	19	19	19	19	19	18	18	18	17	17	17	16	16	16	15	15	14	14	13	13	12	12	12	11	11	11	10
42-	21	20	20	20	20	20	19	19	19	19	18	18	18	17	17	17	16	16	16	15	15	14	14	13	13	13	12	12	11	11	11
43-	21	21	20	20	20	20	20	19	19	19	19	18	18	18	17	17	17	16	16	15	15	15	14	14	13	13	13	12	12	11	11
44-	21	21	21	20	20	20	20	20	19	19	19	19	18	18	18	17	17	16	16	15	15	14	14	13	13	12	12	12	11	11	11
45-	21	21	21	21	21	20	20	20	20	19	19	19	19	18	18	18	17	17	16	16	16	15	15	14	14	14	13	13	12	12	11
46-	22	22	21	21	21	21	20	20	20	20	20	19	19	19	18	18	18	17	17	16	16	15	15	15	14	14	13	13	13	12	12
47-	22	22	22	21	21	21	21	21	20	20	20	20	19	19	19	18	18	17	17	17	16	16	15	15	15	14	14	13	13	13	12
48-	22	22	22	22	22	21	21	21	21	21	20	20	20	19	19	19	18	18	17	17	17	16	16	15	15	15	14	14	13	13	12
49-	23	23	22	22	22	22	22	21	21	21	21	20	20	20	19	19	19	18	18	17	17	17	16	16	15	15	15	14	14	13	13
50-	23	23	23	23	23	22	22	22	22	22	21	21	21	20	20	20	19	19	18	18	18	17	17	16	16	16	15	15	14	14	13
51-	24	24	24	23	23	23	23	23	22	22	22	22	21	21	21	20	20	19	19	19	18	18	17	17	17	16	16	15	15	14	14
52-	24	24	24	24	24	24	23	23	23	23	22	22	22	22	21	21	20	20	20	19	19	18	18	18	17	17	16	16	15	15	15

DAILY DEGREE-DAYS FOR PREDICTION OF OPTIMUM SPRAY DATE FOR NANTUCKET PINE TIP MOTH

MAXIMUM TEMP *FAHRENHEIT*

MINIMUM TEMP *FAHRENHEIT*	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48
53-	15	14	14	14	13	13	12	12	11	11	11	10	10	9	9	9	8	8	7	7	6	6	6	5	5	4					
54-	15	15	15	14	14	13	13	12	12	12	11	11	10	10	10	9	9	8	8	7	7	7	6	6	5						
55-	16	16	15	15	14	14	13	13	13	12	12	11	11	11	10	10	9	9	8	8	8	7	7	6							
56-	17	16	16	15	15	14	14	14	13	13	12	12	12	11	11	10	10	9	9	9	8	8	7								
57-	17	17	16	16	15	15	15	14	14	13	13	13	12	12	11	11	10	10	10	9	9	8									
58-	18	17	17	16	16	16	15	15	14	14	14	13	13	12	12	11	11	11	10	10	9										
59-	18	18	17	17	17	16	16	15	15	15	14	14	13	13	12	12	12	11	11	10											
60-	19	18	18	18	17	17	16	16	16	15	15	14	14	13	13	13	12	12	11												
61-	19	19	19	18	18	17	17	17	16	16	15	15	14	14	14	13	13	12													
62-	20	20	19	19	18	18	18	17	17	16	16	15	15	15	14	14	13														
63-	21	20	20	19	19	19	18	18	17	17	16	16	16	15	15	14															
64-	21	21	20	20	20	19	19	18	18	17	17	17	16	16	15																
65-	22	21	21	21	20	20	19	19	18	18	18	17	17	16																	
66-	22	22	22	21	21	20	20	19	19	19	18	18	17																		
67-	23	23	22	22	21	21	20	20	20	19	19	18																			
68-	24	23	23	22	22	21	21	21	20	20	19																				
69-	24	24	23	23	22	22	22	21	21	20																					
70-	25	24	24	23	23	23	22	22	21																						
71-	25	25	24	24	24	23	23	22																							
72-	26	25	25	25	24	24	23																								
73-	26	26	26	25	25	24																									
74-	27	27	26	26	25																										
75-	28	27	27	26																											
76-	28	28	27																												
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DAILY DEGREE-DAYS FOR PREDICTION OF OPTIMUM SPRAY DATE FOR NANTUCKET PINE TIP MOTH

MAXIMUM TEMP *FAHRENHEIT*

MINIMUM TEMP *FAHRENHEIT*	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79
53-	25	25	25	24	24	24	24	24	23	23	23	23	22	22	22	21	21	21	20	20	19	19	19	18	18	17	17	16	16	16	15
54-	26	25	25	25	25	25	24	24	24	24	24	23	23	23	22	22	22	21	21	20	20	20	19	19	18	18	17	17	17	16	16
55-	26	26	26	26	25	25	25	25	25	24	24	24	24	23	23	23	22	22	21	21	21	20	20	19	19	18	18	18	17	17	16
56-	27	26	26	26	26	26	26	25	25	25	25	24	24	24	24	23	23	22	22	22	21	21	20	20	19	19	19	18	18	17	17
57-	27	27	27	27	26	26	26	26	26	25	25	25	25	24	24	24	23	23	23	22	22	21	21	20	20	20	19	19	18	18	18
58-	28	28	27	27	27	27	27	26	26	26	26	26	25	25	25	24	24	24	23	23	22	22	21	21	21	20	20	19	19	19	18
59-	28	28	28	28	28	27	27	27	27	27	26	26	26	26	25	25	25	24	24	23	23	22	22	22	21	21	20	20	20	19	19
60-	29	29	28	28	28	28	28	28	27	27	27	27	26	26	26	26	25	25	24	24	23	23	23	22	22	21	21	21	20	20	19
61-	29	29	29	29	29	28	28	28	28	28	27	27	27	27	26	26	26	25	25	24	24	24	23	23	22	22	22	21	21	20	20
62-	30	30	30	29	29	29	29	29	28	28	28	28	28	27	27	27	26	26	25	25	25	24	24	23	23	23	22	22	21	21	20
63-	30	30	30	30	30	30	29	29	29	29	29	28	28	28	28	27	27	26	26	26	25	25	24	24	24	23	23	22	22	21	21
64-	31	31	31	30	30	30	30	30	30	29	29	29	29	28	28	28	27	27	27	26	26	25	25	25	24	24	23	23	22	22	22
65-	31	31	31	31	31	31	30	30	30	30	30	30	29	29	29	28	28	28	27	27	26	26	26	25	25	24	24	23	23	23	22
66-	32	32	32	32	31	31	31	31	31	30	30	30	30	30	29	29	29	28	28	27	27	27	26	26	25	25	24	24	24	23	23
67-	32	32	32	32	32	32	32	31	31	31	31	31	30	30	30	30	29	29	28	28	28	27	27	26	26	25	25	25	24	24	23
68-	33	33	33	33	32	32	32	32	32	32	31	31	31	31	30	30	30	29	29	29	28	28	27	27	26	26	26	25	25	24	24
69-	33	33	33	33	33	33	33	32	32	32	32	32	32	31	31	31	30	30	30	29	29	28	28	27	27	27	26	26	25	25	25
70-	34	34	34	34	33	33	33	33	33	33	33	32	32	32	32	31	31	31	30	30	29	29	28	28	28	27	27	26	26	26	25
71-	34	34	34	34	34	34	34	34	33	33	33	33	33	32	32	32	32	31	31	30	30	29	29	29	28	28	27	27	27	26	26
72-	35	35	35	35	35	34	34	34	34	34	34	33	33	33	33	32	32	32	31	31	30	30	30	29	29	28	28	28	27	27	26
73-	35	35	35	35	35	35	35	35	34	34	34	34	34	34	33	33	33	32	32	31	31	31	30	30	29	29	29	28	28	27	27
74-	36	36	36	36	36	35	35	35	35	35	35	35	34	34	34	34	33	33	32	32	32	31	31	30	30	30	29	29	28	28	27
75-	36	36	36	36	36	36	36	36	36	35	35	35	35	35	34	34	34	33	33	33	32	32	31	31	31	30	30	29	29	28	28
76-	37	37	37	37	37	36	36	36	36	36	36	36	35	35	35	35	34	34	33	33	32	32	32	32	31	31	30	30	29	29	29
77-	37	37	37	37	37	37	37	37	37	36	36	36	36	36	36	35	35	35	34	34	33	33	33	32	32	31	31	30	30	30	29
78-	38	38	38	38	38	37	37	37	37	37	37	37	37	36	36	36	36	35	35	34	34	34	33	33	32	32	31	31	31	30	30
79-	38	38	38	38	38	38	38	38	38	38	37	37	37	37	37	36	36	36	35	35	35	34	34	33	33	32	32	32	31	31	30
80-	39	39	39	39	39	38	38	38	38	38	38	38	38	37	37	37	37	36	36	36	35	35	34	34	33	33	33	32	32	31	
81-	39	39	39	39	39	39	39	39	39	39	38	38	38	38	38	38	37	37	37	36	36	35	35	34	34	34	33	33	32		
82-	40	40	40	40	39	39	39	39	39	39	39	39	39	39	38	38	38	38	37	37	36	36	35	35	35	34	34	33			
83-	40	40	40	40	40	40	40	40	40	40	39	39	39	39	39	39	38	38	38	37	37	36	36	36	35	35	34				
84-	41	41	40	40	40	40	40	40	40	40	40	40	40	40	39	39	39	39	38	38	37	37	37	36	36	35					
85-	41	41	41	41	41	41	41	41	41	41	40	40	40	40	40	40	40	39	39	38	38	38	37	37	36						
86-	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	40	40	40	39	39	39	38	38	37							
87-	42	42	42	42	42	42	42	42	41	41	41	41	41	41	41	41	41	40	40	40	39	39	38								
88-	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	41	41	41	41	40	40	39									
89-	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	41	41	40										
90-	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	42	42	42	42	41											
91-	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	42												
92-	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43													
93-	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43														
94-	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43															
95-	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43																
96-	43	43	43	43	43	43	43	43	43	43	43	43	43	43																	
97-	43	43	43	43	43	43	43	43	43	43	43	43	43																		
98-	43	43	43	43	43	43	43	43	43	43	43	43																			
99-	43	43	43	43	43	43	43	43	43	43	43																				
100-	43	43	43	43	43	43	43	43	43	43																					
101-	43	43	43	43	43	43	43	43	43																						
102-	43	43	43	43	43	43	43	43																							
103-	43	43	43	43	43	43	43																								
104-	43	43	43	43	43	43																									

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